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[Med. Entomol. Zool. Vol. 59 No. 4 p. 319–324 2008]

Simulium (*Gomphostilbia*) *rarum* sp. nov., a new species of black fly (Diptera: Simuliidae) from Palawan Island, the Philippines

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(Received: 8 July 2008; Accepted: 18 August 2008)

Abstract: *Simulium* (*Gomphostilbia*) *rarum* sp. nov. is described from two males reared from pupae collected from Palawan Island, the Philippines. This new species is characterized in the male by the elongate calcipala extending beyond the middle of the second tarsal segment and the ventral plate much produced ventrally and also dorsally, and in the pupa by the eight gill filaments arranged in groups of (2+1)+(1+2)+2 filaments from dorsal to ventral and the absence of grapnel-shaped hooklets on each lateral side of the last abdominal segment. This new species is very similar to *S.* (*G.*) *lehi* Takaoka from Sarawak, Malaysia, and *S.* (*G.*) *miblosi* Takaoka from Mindanao, the Philippines, but barely distinguished by the pupal frons sparsely covered with round tubercles.

Key words: black fly, Simuliidae, Palawan, Philippines, taxonomy

The simuliid fauna of Palawan Island, the Philippines, consists of 20 species in the genus *Simulium*, of which eight were placed in the subgenus *Gomphostilbia*, two in *Nevermannia*, nine in *Simulium* and one in *Wallacellum* (Delfinado, 1971; Takaoka, 1983; Takaoka and Tenedero, 2007, 2008).

In this paper, we describe one more new species belonging to the subgenus *Gomphostilbia* on the basis of two males reared from pupae.

The terms for morphological features used here follow those of Takaoka (2003). Type specimens of the new species are deposited at the Department of Infectious Disease Control, Faculty of Medicine, Oita University, Oita, Japan.

Simulium (*Gomphostilbia*) *rarum* sp. nov.

DESCRIPTION. **Male**. Body length 2.1 mm. ***Head***. Wider than thorax. Upper eye consisting of 12 or 13 vertical columns and 12 horizontal rows of large facets. Face dark brown. Clypeus dark brown, densely covered with yellow scale-like short to medium-long hairs (except medial portion of lower 1/2 bare) interspersed with several dark brown simple longer hairs on lower 1/2. Antenna composed of scape, pedicel and 9 flagellomeres, yellow on scape, pedicel and base of 1st flagellomere, becoming slightly dark toward 4th or 5th flagellomere, then light brown on remaining apical flagellomeres; 1st flagellomere elongate, 1.62 times as long as 2nd one. Maxillary palp with 5 segments, light brown, proportional lengths of 3rd, 4th, and 5th segments 1.00: 1.03: 2.91; 3rd segment (Fig. 1A) of moderate size; sensory vesicle (Fig. 1A) ellipsoidal, small, 0.20 times as long as 3rd segment, and with medium-sized opening. ***Thorax***. Scutum dark brown to brownish-black, with 3 faint dark narrow longitudinal vittae, shiny when illuminated at certain angle of light, densely covered with golden-yellow short hairs; scutellum dark brown to brownish-black, with golden-yellow short hairs and dark brown long upright hairs. Postnotum dark brown to brownish-black, shiny when illuminated at cer-

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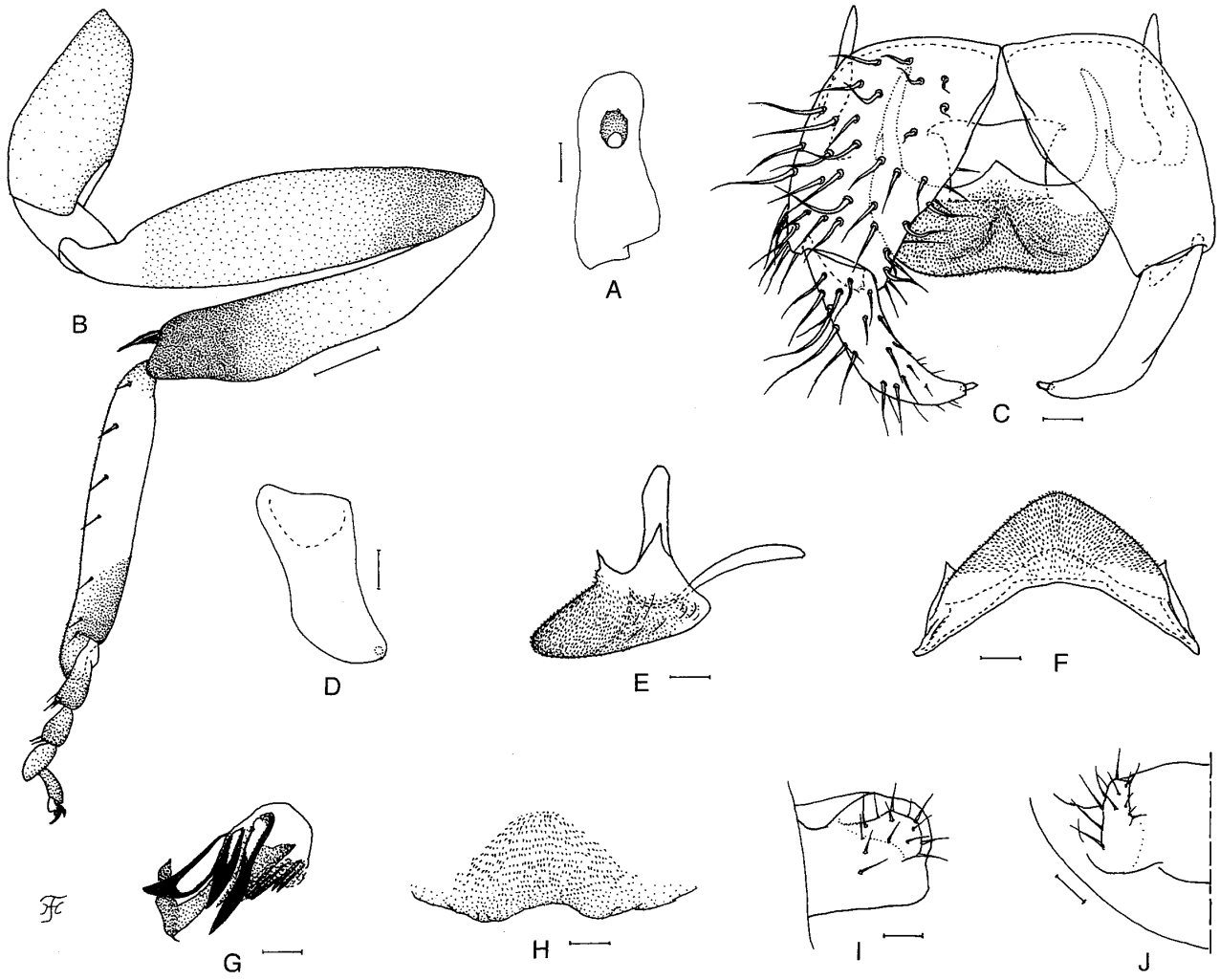

Fig. 1. Male of *Simulium* (*Gomphostilbia*) *rarum* sp. nov. A, 3rd segment of maxillary palp with sensory vesicle (right side and front view); B, hind leg (left side and outer view); C, coxites, styles, ventral plate and median sclerite *in situ* (ventral view); D, style (right side and ventrolateral view); E, ventral plate and median sclerite *in situ* (lateral view); F, ventral plate (end view); G, paramere (right side and end view); H, aedeagal membrane and dorsal plate (end view); I and J, 10th abdominal segment and cercus (right side; I, lateral view; J, end view). Scale bars. 0.1 mm for B; 0.02 mm for A and C–J.

tain angle of light, and bare. Pleural membrane bare. Katepisternum medium to dark brown, longer than deep, moderately covered with dark brown short hairs and golden-yellow ones. ***Legs***. Foreleg: coxa yellowish-white; trochanter light brown; femur light brown; tibia light to medium brown except extreme base yellowish-white, moderately covered with golden-yellow hairs on outer surface of basal 3/4; tarsus dark brown to brownish-black, with moderate dorsal hair crest; basitarsus moderately dilated, 7.18 times as long as its greatest width. Midleg: coxa medium brown except posterior surface dark brown; trochanter dark yellow; femur light brown; tibia light to medium brown except little more than basal 1/4 yellowish-white, moderately covered with golden-yellow hairs on posterior and outer surface of basal 3/4; tarsus medium to dark brown except extreme base of basitarsus yellow, slightly more than basal 1/2 of basitarsus, base of 2nd segment, and all of segment 4 light brown; basitarsus moderately covered with golden-yellow hairs on basal 3/5. Hind leg (Fig. 1B): coxa dark yellow to light brown; trochanter yellowish-white; femur light brown except base yellowish-white and apical cap dark brown; tibia yellowish-white on basal 1/3, light brown on middle 1/3, dark brown to brownish-black on apical 1/3, moderately covered with golden-yellow hairs on basal 4/5; tarsus dark brown to brownish-black except

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basal 2/3 of basitarsus and basal 1/2 of 2nd tarsal segment yellowish-white though base of basitarsus dark brown; basitarsus narrow, nearly parallel-sided, 5.75 times as long as wide, and 0.57 and 0.50 times as wide as greatest widths of tibia and femur, respectively; calcipala elongate, extending little beyond middle of 2nd tarsal segment, 1.63 times as long as wide, and 0.58 times as wide as greatest width of basitarsus; pedisulcus well developed. ***Wing***. Length 1.5 mm. Costa with dark spinules and hairs except basal portion with patch of golden-yellow hairs. Subcosta bare. Hair tuft on stem vein golden-yellow. Basal portion of radius fully haired; R_1 with dark spinules and hairs; R_2 with dark hairs only. Basal cell absent. ***Abdomen***. Basal scale dark brown to brownish-black, with fringe of dark long hairs. Dorsal surface of abdomen medium brown to brownish-black except basal 1/2 or little more of 2nd segment yellow, covered with dark short to long hairs; segments 2 and 5–9 each with pair of shiny dorsolateral or lateral patches, of which those on segment 2 broadly connected in middle to each other. ***Genitalia***. Coxite in ventral view (Fig. 1C) nearly rectangular, 1.73 times as long as its greatest width. Style in ventral view (Fig. 1C) slender, nearly parallel-sided along basal 2/3, then tapered toward apex, 0.80 times as long as coxite, gently bent inward, with apical spine; style in ventrolateral view (Fig. 1D) slightly narrowed from base to basal 1/3, then nearly parallel-sided to apical 1/3, and tapered toward apex, with blunt apex. Ventral plate in ventral view (Fig. 1C) transverse, 0.48 times as long as wide, widest near anterior margin, slightly narrowed posteriorly, with anterior margin produced anteromedially, and posterior margin very slightly concave medially, and densely covered with microsetae on ventral surface; basal arms of moderate length, nearly parallel-sided, then slightly converged apically; ventral plate in lateral view (Fig. 1E) much produced ventrally and also dorsally; ventral plate in end view (Fig. 2F) rounded ventrally, and densely covered with microsetae on posterior surface except both lateral areas mostly bare. Median sclerite (Fig. 1C, E) thin, plate-like, wide, connected to ventral plate near anterior margin. Paramere (Fig. 1G) of moderate size, each with 3 distinct long and stout hooks and several smaller ones close together near apex. Aedeagal membrane (Fig. 1H) moderately setose, weakly sclerotized basally forming lightly-pigmented dorsal plate (Fig. 1H). Ventral surface of 10th abdominal segment (Fig. 1I, J) without distinct hairs near posterior margin on each side. Cercus (Fig. 1I, J) rounded, with 12 or 13 hairs.

Pupa. Body length 2.5 mm. ***Head***. Integument yellow, sparsely covered with small round tubercles (Fig. 2A); antennal sheath without any protuberances or tubercles; frons with 3 pairs of simple very long trichomes with coiled apices (Fig. 2B), and face with pair of simple very long trichomes with coiled apices (Fig. 2C); 3 frontal trichomes on each side arising close together, subequal in length to one another and much longer than facial one. ***Thorax***. Integument yellow, sparsely covered with round tubercles, with 3 simple very long mediodorsal trichomes with coiled apices (Fig. 2D), 2 simple very long anterolateral trichomes (1 stout, with coiled apex, 1 slender, with uncoiled apex) (Fig. 2E), 1 simple medium-long posterolateral trichome with uncoiled apex (Fig. 2F) and 3 simple medium-long ventrolateral trichomes with uncoiled apices (Fig. 2 G) on each side. Gill (Fig. 2H) composed of 8 slender thread-like filaments, slightly shorter than pupal body, arranged in groups of (2+1)+(1+2)+2 filaments from dorsal to ventral, with somewhat swollen transparent organ ventrally (partially broken) at base; stalks of dorsal and middle triplets and that of ventral pair arising at same level from short common basal stalk; dorsal triplet composed of 1 individual and 2 paired filaments with very short stalk; middle triplet composed of 1 individual and 2 paired filaments with short stalk; stalk of ventral paired filaments medium-long, slightly longer than primary and secondary stalks of middle triplets together, 1.1 times as thick as stalks of dorsal and middle triplets which are subequal in thickness, and slightly shorter and thinner than interspiracular trunk; stalk of upper triplet lying against that of ventral pair at angle of about 60 degrees when viewed laterally; all filaments light brown, gradually tapered toward apex, appearing subequal in length (1.8–2.1 mm long) and thickness, though 2 filaments of ventral pair and inner filament of paired filaments of middle triplet slightly thicker than others when compared basally; cuticle of all filaments with well marked annular ridges and furrows though becoming less marked apically, densely covered with minute

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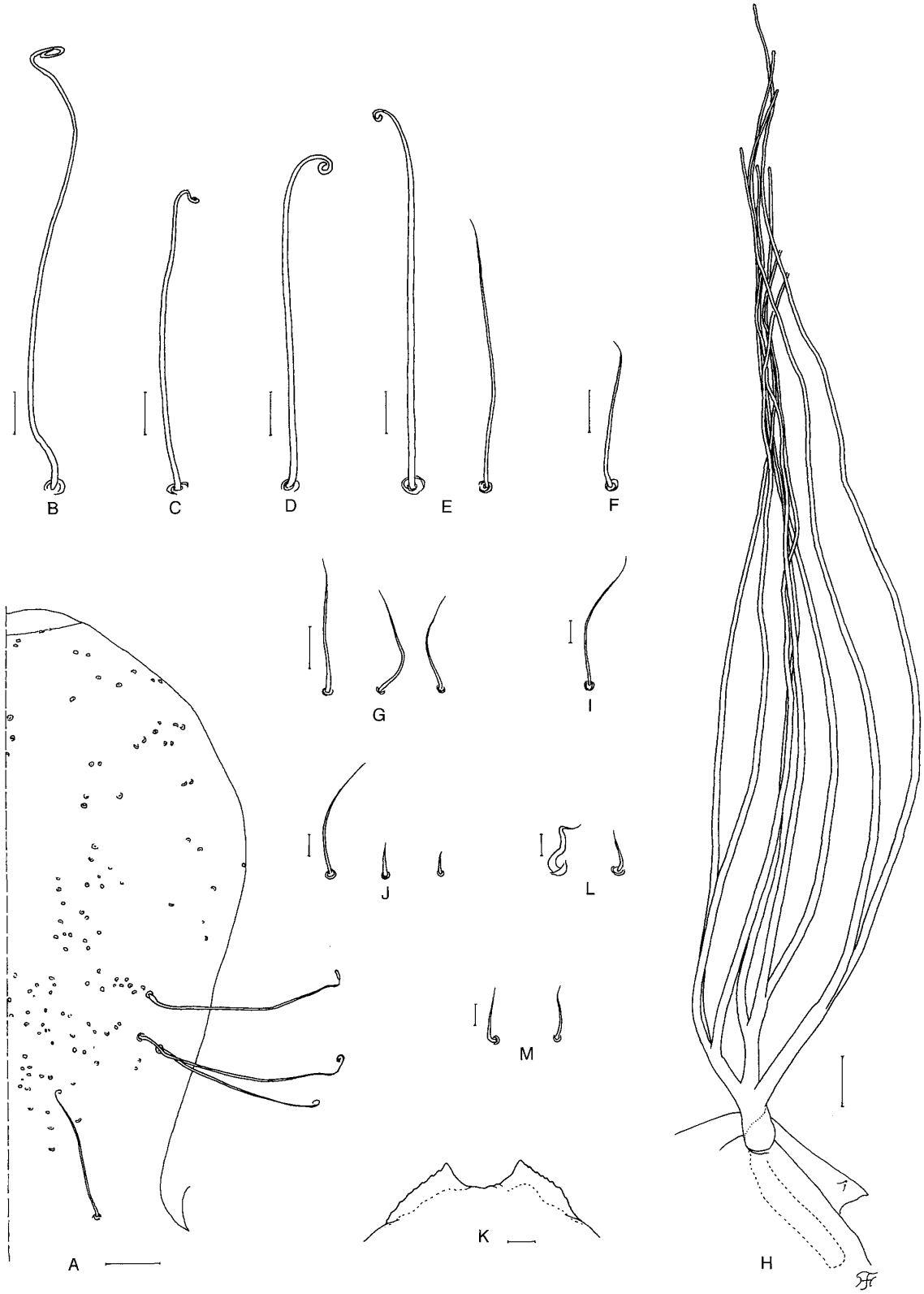

Fig. 2. Pupa of *Simulium* (*Gomphostilbia*) *rarum* sp. nov. A, frons and portion of face (left half); B, frontal trichome; C, facial trichome; D–G, thoracic trichomes (D, mediodorsal; E, anterolateral; F, posterolateral; G, ventrolateral); H, gill filaments (right side and lateral view); I, hair-like seta on dorsal surface of abdominal segment 1; J, hair-like seta and 2 very short setae of different sizes; K, plate-like terminal hooks (anterodorsal view); L, stout hooklet and very short seta on ventral surface of abdominal segment 4; M, 2 short colorless setae on each lateral side of abdominal segment 9. Scale bars. 0.1 mm for H; 0.04 mm for A; 0.02 mm for B–G; 0.01 mm for I–M.

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tubercles. ***Abdomen***. Dorsally, segments 1 and 2 with no tubercles; segment 1 with 1 simple slender medium-long hair-like seta (Fig. 2I) on each side; segment 2 with 1 simple slender medium-long hair-like seta and 5 very short setae of which 3 are somewhat longer and stouter than 2 others submedially (Fig. 2J) on each side; segments 3 and 4 each with 4 hooked spines and 1 very short somewhat spinous seta on each side; segment 5 lacking spine-combs; segments 6–9 each with spine-combs in transverse row and comb-like groups of minute spines on each side; segment 9 with pair of distinct flat plate-like terminal hooks extending laterally at base and having weakly serrated outer margin (Fig. 2K). Ventrally, segment 4 with 1 simple short brown hooklet and few simple slender very short setae (Fig. 2L) on each side; segment 5 with pair of bifid hooks submedially and few very short simple slender setae on each side; segments 6 and 7 each with pair of bifid or trifid inner and simple outer hooks somewhat spaced from each other and few very short simple slender setae on each side; segments 4–8 with comb-like groups of minute spines. Each side of segment 9 with 2 simple colorless setae (Fig. 2M) and without grapnel-shaped hooklets. ***Cocoon***. Wall-pocket shaped, thinly and neatly woven, widely extending ventrolaterally; anterior margin somewhat thickly woven, without any bulge or projection anterodorsally; posterior 1/2 with floor moderately woven; individual threads visible; 3.0–3.2 mm long by 2.5–2.6 mm wide.

Female and **Mature larva**. Unknown.

TYPE SPECIMENS. Holotype male (with its associated pupal exuviae and cocoon) in ethanol, reared from a pupa collected from a mountain stream (width 2–3 m, stream bed rocky and stony, water temperature 22.3℃, shaded, altitude 250 m), moderately flowing in the natural forest, foot of Mt. Taltalaba, near the road from Montible to the west coast, Mabuhay, Napsan, Palawan, Philippines, 1. IV. 2008, by H. Takaoka and V. F. Tenedero. Paratype, 1 male (with its associated pupal exuviae and cocoon) reared from a pupa collected from a mountain stream (width 0.5–2.0 m, stream bed stony, water temperature 21.0℃, shaded, altitude 690 m), slowly flowing in the natural forest of Mt. Taltalaba, Mabuhay, Napsan, Palawan, Philippines, 2. IV. 2008, by H. Takaoka.

ECOLOGICAL NOTES. The pupae of this new species were collected from tree leaves fallen in the water. Associated species were *S.* (*G.*) *epistum* Delfinado, *S.* (*G.*) *montiblense* Takaoka, *S.* (*Simulinm*) *iwahigense* Takaoka, *S.* (*S.*) *subatrum* Takaoka and *S.* (*S.*) *quasifrenum* Delfinado.

ETYMOLOGY. The species name *rarum* refers to the scattered tubercles on the pupal frons. The Latin word "rarus" means "scattered".

REMARKS. *Simulium* (*G.*) *rarum* sp. nov. is assigned to the *batoense* species-group within the subgenus *Gomphostilbia* in that it has antennae with 11 segments, the pleural membrane bare, and a slender hind basitarsus (Fig. 1B) in the male, and eight gill filaments arranged in groups of 3+3+2 filaments (Fig. 2H) in the pupa.

This new species is distinctive among the subgenus *Gomphostilbia* in that it lacks grapnel-shaped hooklets on each lateral side of the ninth pupal abdominal segment. In this aspect, *S.* (*G.*) *rarum* sp. nov. appears to be related to *S.* (*G.*) *asperum* Takaoka described from Halmahera (Takaoka, 2003), *S.* (*G.*) *lehi* Takaoka described from Sarawak (Takaoka, 2001), *S.* (*G.*) *miblosi* Takaoka described from Mindanao (Takaoka, 1983), all of the *batoense* species-group, and *S.* (*G.*) *mamasaense* Takaoka described from Sulawesi, unplaced to any species-group (Takaoka, 2003). However, *S.* (*G.*) *rarum* sp. nov. is readily distinguished in the pupa from *S.* (*G.*) *asperum* by the plate-like terminal hooks (Fig. 2K) (c.f., cone-like terminal hooks in *S.* (*G.*) *asperum*), from *S.* (*G.*) *mamasaense* by the gill filaments arranged in (2+1)+(1+2)+2 filaments (Fig. 2H) (c.f., arranged in [(1+2)+(1+2)]+2 in *S.* (*G.*) *mamasaense*), and from *S.* (*G.*) *lehi* and *S.* (*G.*) *miblosi* by the medium-long stalk of

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the ventral paired filaments slightly longer than the primary and secondary stalks of the middle triplet combined, and the frons sparsely covered with tubercles (Fig. 2A) (c.f., the stalk of the ventral paired filaments short, even shorter than the primary stalk of the middle triplet, and the frons densely covered with tubercles in the two known species). On the other hand, the male of this new species is very similar to those of *S.* (*G.*) *lehi* and *S.* (*G.*) *miblosi* (unpublished data; though the male of *S.* (*G.*) *miblosi* has not been described yet, male specimens reared from pupae recently collected from Mindanao were available for morphological study) in many characteristics including the elongate calcipala extending beyond the middle of the second tarsal segment and the ventral plate much produced ventrally. The male of *S.* (*G.*) *rarum* sp. nov. barely differs from that of *S.* (*G.*) *lehi* by the number of vertical columns of the large upper-eye facets (12 or 13 versus 10) and from that of *S.* (*G.*) *miblosi* by the color of the fore tibia (almost entirely light to medium brown versus yellowish white on the basal 2/3 and brownish-black on the rest).

This new species is easily distinguished from all the eight known species of the subgenus *Gomphostilbia* recorded from Palawan Island by the absence of the grapnel-shaped hooklets on each side of the last abdominal segment as well as the arrangement of the pupal gill filaments.

Acknowledgements

We are grateful to Prof. Peter H. Adler, Clemson University, USA, for reading the manuscript and giving valuable comments. Thanks are due to Prof. Lilian A. de las Llagas, University of the Philippines, for her support to this study. This study was financially supported by a Grant-in-Aid for Oversea Research from the Japan Society for the Promotion of Science (No. 18406011).

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